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A Case Study on Summer Distribution of Zooplankton in Chilika Lagoon, East Coast of INDIA

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ABSTRACT:
Zooplankton represents a very complex group of organisms. It contains the representatives of almost all the animal phyla occurring either as holoplankton or meroplankton. They are of immense ecological importance because the fate of energy and material flow depend on them. The present study on zooplankton distribution was undertaken in the Central Sector of the Chilika Lagoon (Orissa), a wetland of international importance. The period of study was confined to the pre-monsoon summer months of March and April 2009. Important hydrographic parameters such as Depth, Transparency, Air and Water temperature, Salinity, pH and Dissolved Oxygen were measured during the present study simultaneously with the study of the qualitative and quantitative aspects of Zooplankton. The measured depth values varied between 0.9 and 1.8 m. Secchi disc depths ranged from 0.85 - 1.65 m. Except salinity and pH, the mean values of other parameters in all the stations found to be high in April than in March. Zooplankton population was copepod dominant at all the stations in both the months. In total, 73 species of Zooplankton, mostly belonging to Crustacea, Chaetognatha, Molusca, among the holoplankton and 11 different types of larval forms were encountered. The population density ranged from 96 org. m^{-3} to 240 org. m^{-3} with highest density at station C1 with 240 organisms m^{-3}.

Keywords: *Species composition, Relative abundance, Copepod, Salinity, pH, Premonsoon*

INTRODUCTION

Oceans are Earth's most distinctive feature covering about 71% (362,000,000 sq.km) of its surface. About 61% of the northern hemisphere and 81% of the southern hemisphere of the Earth are covered by sea water. History of ocean provides that the first life on Earth that had come into existence was in sea water. Oceans are associated with various coastal landforms *viz.* bays, backwaters, estuaries, lagoons, mangrove swamps, creeks, fjords, shallow seas *etc.*, rich with vast groups and varied forms of life ranging from microbes to plants and animals. Many of these organisms are used as nutritious food, animal feed, and sources of novel chemicals of industrial applications.

The entire spectrum of life found in the pelagic realm of oceans and their associated coastal embayment are classified as three basic types viz. plankton, nekton and pleuston. The plankton community is categorized into three groups: (1) phytoplankton (plants), (2) zooplankton (animals), and (3) bacterioplankton (bacteria).

The phytoplankton and bacterioplankton are quantitatively more abundant than zooplankton. Taxonomically, zooplankton constitutes a very heterogeneous community with members from all most all phylum of the animal realm. Zooplankton are of two types such as (i) "holoplankton" and (ii) "meroplankton". In context of Orissa, zooplankton studies were limited to a few estuaries. So the present case study is a report on species composition and distribution of zooplankton in the Central Sector of the Chilika during pre-monsoon summer months of 2009.

MATERIALS AND METHODS

Study Area

Chilika lagoon (Fig 1) is the largest brackish water lagoon in the Asian continent. It is situated between Lat. 19˚28'-19˚54'N and Long. 85˚06'- 85˚35' E in Odisha along the east coast of India. It has been honoured as an important Ramsar site of east coast [1]. This pear shaped water body forms one of the unique ecospheres of the world with unmatched biodiversity. The lake caters the socio-economic needs of the people of Odisha in various diversified areas of earning livelihood.

Methodology

The water and plankton samples were collected from five selected stations (Fig -1) of the Central Sector of the Chilika Lagoon. Two sampling surveys, one in each month, were conducted during premonsoon months of March and April 2009. At each location, surface water samples were collected to determine hydrographic parameters. Air and water temperatures were measured using a thermometer of 0.1^{o} C accuracy. The pH of the water sample was recorded by a digital field pH meter (Model Eutech pH scan 2) with ± 0.1 accuracy. Water transparency was measured at each station using a Secchi disc. Water samples for estimation of salinity and dissolved oxygen were carried out following standard methods described in APHA, 1998 [2]. Zooplankton samples were collected at each station by horizontal haul using a conical plankton net, (mesh size of 120 micrometer). All the qualitative and quantitative parameters were assessed following the standard procedure enumerated by Kasturirangan (1963) [3], Newell and Newell (1977)

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[4] and Conway *et al* (2003) [5]. During the present study, for the purpose of computing relative abundance, the zooplankton populations were first divided into two major groups: the holoplankton and meroplankton. The holoplankton were represented mainly by three major crustaceans sub- groups such as Copepods, Mysids, and other crustaceans (Lucifer, , ostracod, cladocerans , euphausiids etc); chaetognaths and others which included the dolioloids, salps and appendicularians from tunicates, siphonophores, pteropods, tintinnids, gastropods, foraminifers etc.

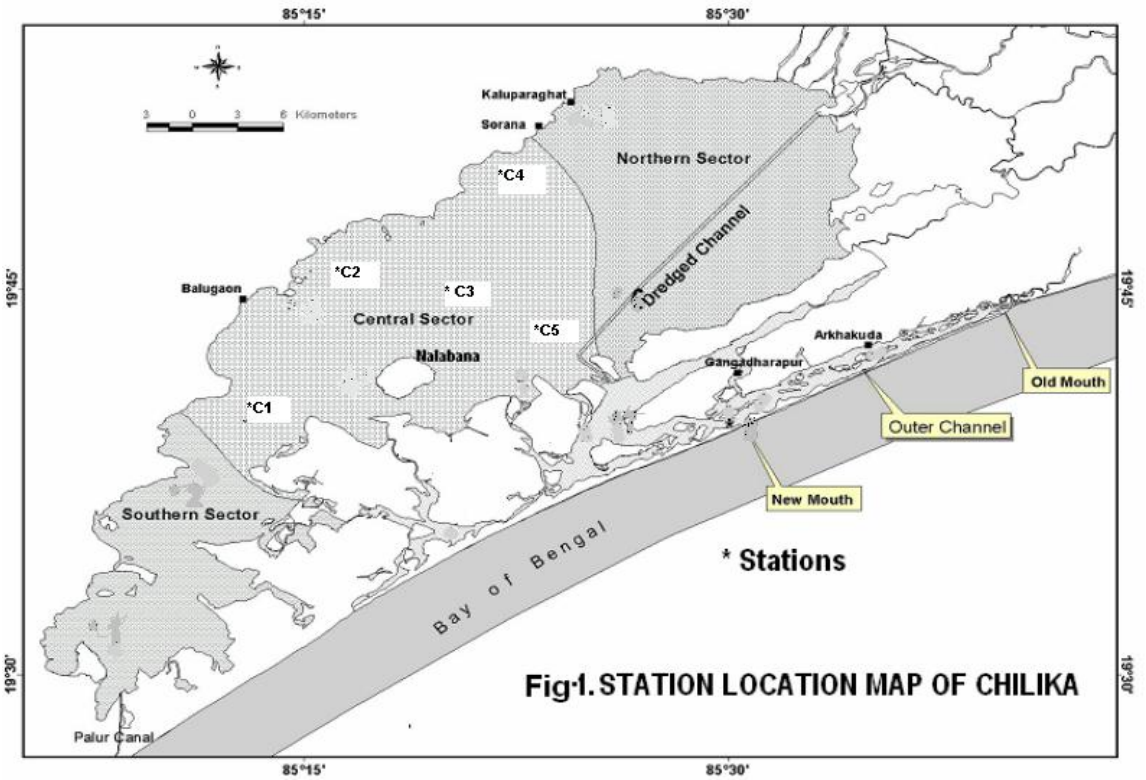

Fig.1 Map of Chilika lagoon showing the central sector sampling stations (C1-C5)

Table 1: Variations in Hydrographical Parameters in the Central Sector of Chilika Lagoon during March 2009

Station	Depth (m)	Trans-parency	k value	Temperature		Salinity	pH	DO (ml/l)
				Air	Water			
C1	1.5	1.32	1.13	32.04	30.0	20.28	7.9	8.2
C2	1.7	1.45	1.03	31.05	30.9	19.27	7.6	6.1
C3	1.3	0.95	1.57	30.00	29.4	11.9	8.1	5.87
C4	1.6	1.43	1.04	29.09	28.9	13.7	7.83	4.3
C5	0.9	0.85	1.76	33.05	32.8	16.9	8.21	5.24
Mean	1.4	1.20	1.30	31.38	30.4	16.41	7.92	5.94
SD	0.32	0.28	0.34	1.58	1.53	3.57	0.24	1.44

Table 2: Variation of Hydrographical Parameters in the Central Sector of Chilika Lagoon during April 2009.

Station	Depth (m)	Trans-parency	k value	Temperature		Salinity	pH	DO (ml/l)
				Air	Water			
C1	1.23	0.92	1.63	34.3	33.9	10.7	7.7	8.8
C2	1.4	1.21	1.23	32.8	30.7	13.43	7.81	6.7
C3	1.3	0.96	1.56	31.5	29.9	15.82	8.1	5.4
C4	1.8	1.65	0.90	33.8	30.6	21.6	7.0	8.4
C5	1.5	1.30	1.15	30.9	29.8	14.92	8.2	6.0
Mean	1.44	1.20	1.29	32.66	30.98	15.29	7.76	7.06
SD	0.22	0.30	0.30	1.45	1.68	4.02	0.47	1.49

RESULTS AND DISCUSSION

Hydrographic Parameters

Hydrographic character in an estuarine and lagoonal ecosystem is controlled by the combined influence of the ongoing physical, chemical and biological processes.

All the seven hydrographic parameters such as Depth, Transparency, Air temperature, Water temperature, Salinity, pH and Dissolved Oxygen showed visible spatial variations during the present study. The range and mean values of hydrographical parameter are given in Table 1 and Table 2 for March and April respectively.

The depth of water column varied from 0.9 - 1.7 m yielding a mean value of 1.4m in March and from 1.2 - 1.8 m with a mean value of 1.44 m in April. Thus, there was no significant variation as regards to the water depth during the study period. The transparency of water column also did not show much variation. The recorded Secchi disc depth values ranged from 0.85 - 1.45 m in March and 0.9 - 1.65 m in April. Temperature, which always remains as a covariate with other environmental factors, considerably influenced the physico-chemical and biological characteristics of an aquatic ecosystem [6]. The temperature variation remained almost identical during both the surveys ranging from $29.9^0 – 33.5^0$C in March and $30.9^0 – 34.3^0$C in April. The mean temperatures of these two months were 31.38^0 C and 32.66^0 C respectively. Salinity variation always plays a key role in the distribution of organisms in estuaries and brackish water lagoons [7], [8]. The salinity values during the present study ranged from 11.9 - 20.28 PSU yielding an average value of 16.41 in March while in April it ranged from 10.7 – 21.6 PSU with an average value of 15.29. The dissolved Oxygen content indicated significant variation with values ranging from 4.3-8.2 ml/L with an average value of 5.94 ml/L in March and 5.4 - 4.8 ml/L yielding an average value of 7.06 ml/L. The observed dissolved oxygen concentration was within the acceptable range i.e. less than 10 mg/l [9]. The pH values ranged from 7.6-8.21 yielding an average value of 7.92 in March and from 7 - 8.2 with an average value of 7.6 in April. Although there was no significant variation in pH, the water column remained alkaline during the period of observation. This is in conformity with the findings of earlier workers [10], [11], [12], [13].

Table 3: Checklist of Zooplankton observed during March-April 2009 in the Central Sector of Chilika Lagoon

HOLOPLANKTON:

Phylum: Protozoa

Class: Ciliata

Order: Tintinnida

Family: Tintinnidae

Tintinnopsis succulus

T. tocantinenesis

Favela philippinensis

Tintinnopsis sp.

Order: Dinoflagellata **Family:** Noctilucaceae

Noctiluca miliaris

Phylum: Coelenterata

Class: Hydrozoa

Order: Hydroida

Family: Campanularidae

Obelia sp.

Liriope sp.

Order: Semaeostomeae

Family: Ulmaridae

Aurelia aurita

Order: Siphonophora

Family: Diphyidae

Diphyes dispar

Sulculeolaria sp.

Lensia sp.

Class: Tentaculata

Order: Cydippida

Family: Pleurobrachiidae

Pleurobrachia globosa

Order: Lobata

Mnemiopsis sp.

Phylum: Annelida

Class: Polychaete

Order: Hydroida

Family: Campanularidae

S.Class: Errantia

Tomopteris sp.

Phylum: Arthropda

Class: Crustacea

S.Class: Brachiopoda **Order:** Cladocera

Family: Polyphemidae

Evadne tergestina

Family: Sididae

Penilia avirostris

S.Class: Ostracoda **Order:** Myodocopida

Family: Cypridinidae

Philomedes sp.

S.Class: Copepoda **Order:** Calanoida

Family: Calanidae

Canthocalanus pauper

Family: Eucalanidae

Eucalanus attenuatus

Eucalanus sp.

Family: Paracalanidae

Acrocalanus gracilis

Acrocalanus similes

A. gibber

Paracalanus dubia

P.parvus

Family: Acartiidae

Acartia chilkaensis

A. erythraea

A. sewelli

A. spinicauda

Family: Centropegidae

Centropages dorsispiinatus

C. tenuiremis

C. furcatus

Centropages sp.

Family: Pontellidae

Labidocera acuta

L.bengalensis

L.minuta

Pontella andersoni

P.securifer

P .herdmani

Calanopia elliptica

Family: Timoridae

Temora discaudata

T. turbinate

Family: Pseudodiaptomidae

Pseudodiaptomus annandalei

P. binghami

Family: Tortanidae

Tortanus forcipatus

T. gracilis

Order: Cyclopoida

Family: Corycaeidae

Copilia vitrea

C. mirabilis

Corycaeus agilis

C. catus

C. danae

C. speciosus

Family: Oithonidae

Oithona rigida

O. similis

O. simplex

O. brevicornis

Order: Harpacticoida

Family: Macrosetellidae

Macrosetella gracilis

Macrosetella sp.

S-Class: Malacostraca **Order:** Amphipoda

Family: Leucothoidae

Leucothoe spinicarpa

Order: Cumacea

Family: Diastylidae

Diastylopsis sp.

Order: Mysidacea

Family: Mysidae

Mesopodopsis orientalis

Neomysis sp.

Euphausiaceae

Family: Euphausiidae

Euphausia sp.

Order: Decapoda

Family: Sergestidae

Lucifer hansenii

Phylum: **Mollusca**

Class: Gastropoda

Order: Pteropoda

Pteropod

Clionina sp.

Thecosomata

Phylum: Chaetognatha

Sagitta enflata

S. bedoti

S. robusta

Phylum: Chordata

S.Phylum: Urochordata **Class:** Thaliacea

Order: Doliolida

Family: Doliolidae

Doliolum sp.

Order: Salpida

Family: Salpidae

Salpa sp.

Class: Larvacea

Family: Fritillariidae

Fritillaria sp.

Family: Oikopleuridae

Oikopleura sp.

MEROPLANKTON:

Larvae of Crustaceans	**Larvae of Molluscs**	**Larvae of Polychaetes**	**Larvae of Echinoderms**	**Larvae of Chordates**
Nauplius	Veliger	Nereid larvae	Bipinnaria	Fish eggs and fish
Zoea		Trochophore		
Megalopa				
Alima				
Mysis				

Table – 4: Spatial variations in Population density of Zooplankton

Station Name	**Population Density (organisms m^{-3})**	
	March	**April**
C1	240	96
C2	151	130
C3	149	110
C4	170	105
C5	108	208
Mean	**163**	**129**

Population Density

The standing stock of zooplankton during the present study is presented by the numerical abundance (Organisms $m^{-3)}$. The population size of zooplankton discerned significant spatial variations (Table - 4). In marine and estuarine waters, the zooplankton populations are always represented by a mixture of Tintinnids, Siphonophores, Polychaetes, Crustaceans, Mollusks, Chaetognath, dolioloids, salps together with an array of larval forms.

The whole bulk of meroplankton was represented by the larvae of crustaceans, larvae of Polychaetes, mollusks and fish eggs and larvae. The relative abundance of different groups is given in Table 5 and Table 6 corresponding of March and April 2009 respectively. The results presented in this table shows that copepods have always dominated the plankton community in their numerical abundance. These observation is consistent with the reports of Madhupratap et al, 1975 [14]; Nair et al, 1981[15]; Bhunia and Choudhury, 1982 [16]; Shanmugam et al, 1986 [17]; Mitra et al, 1990 [18]; Ramaiah et al, 1996 [19];. Madhu et al, 2007 [20]; Damotharan et al, 2010 [21].

CONCLUSIONS

The observation of the present study shows that the faunistic composition more or less in comparable to the earlier studies in 1970s and 1980s.However the appearance of three species of chaetognaths and tunicates in the lake suggested their recruitment into the lake from adjacent Bay of Bengal [22], [23]. This could occur as a result of contemporary changes in the salinity after the opening of second mouth. Availability of 11 different types of larval forms dominated by crustacean larvae depicts the conduciveness of central sector during pre-monsoon period for breeding and spawning of shell fishes crustaceans in the lake as reported by earlier workers [24], [25], [26]. Further intensive and long-term studies are required to evaluate the secondary productivity of the lake on a seasonal basis and also elucidate the plankton biodiversity in the lake.

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